The Spectral Directional Emissivity of Photovoltaic Surfaces

D. Labuhn and S. Kabelac
Institut für Thermodynamik
Universität Hannover
Callinstr. 36
D-30167 Hannover, Germany

The aim of the underlying project is the energetic and entropic evaluation of radiation conversion devices. By formulation of the entropy fluxes involved in a (solar) radiation energy conversion plant, the entropy production rate and thus energy and exergy efficiencies may be calculated and optimized. The main problem is the calculation of the radiation entropy flux leaving the conversion device. The optical properties of the radiating surface must be known for this calculation, i.e. the spectral directional emissivity and the spectral directional degree of polarization in the visible and infrared spectral range.

Because such data usually are not available in a consistent manner, an experimental setup for the measurement of optical properties of surfaces relevant in solar radiation conversion has been developed. This apparatus is capable to detect the spectral directional emissivity and degree of polarization of a sample in the near and middle infrared $4\,\mu m < \lambda < 22\,\mu m$. A FTIR spectrometer is employed to measure radiation intensities. The intensity is calibrated by means of a hohlraum radiator. A validation of the measurement is achieved by comparison with an emissivity standard from external optical laboratories. Details of the measurement technique will be given in the paper.

Results will be given on the emissivity of passive silicon based photovoltaic cells as well as active photovoltaic cells. Polished silicon wafers and some with specially prepared surface structures are used as a reference material. Preliminary results on the entropy production rates due to emission and reflection of radiation will be given.